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FISHERIES AND MARINE BIOLOGICAL SURVEY DIVISION.

FISHERIES BULLETIN No. 3.

THE Fisheries Research Ship "Africana II".

by

J. M. MARCHAND, M.B.E., M.Sc., Ph.D., Assistant Director.

R. L. V. SHANNON, O.B.E., Master.

and

A. CLARK, M.I.E.S., M.I. MAR. E., Chief Engineer.

G.P.-S.9468—1951-2—600.
(Req. 817-3/12/51.)

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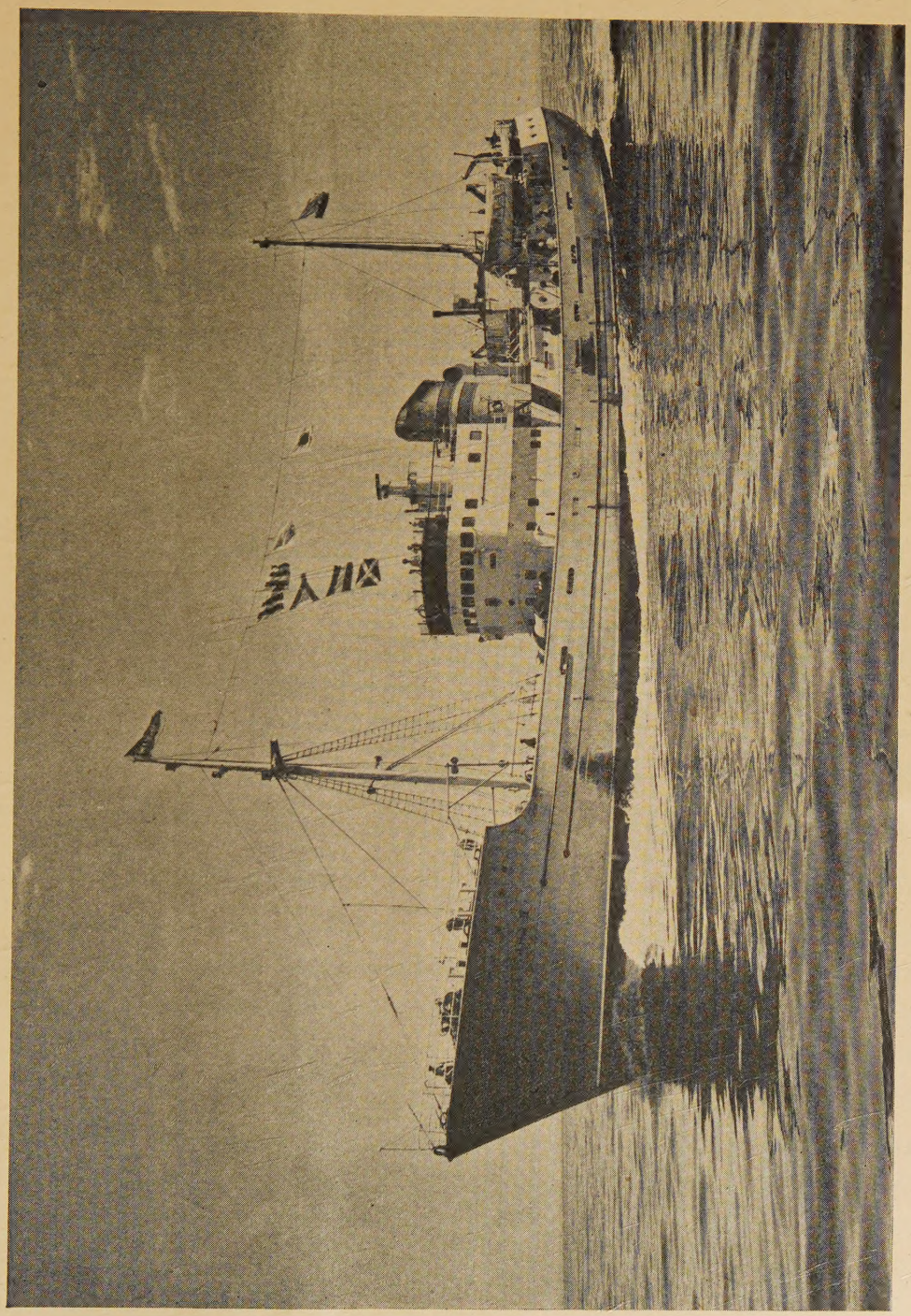
Frontispiece.



F.R.S. " Africana II " Arriving in Table Bay, 22nd February, 1950, after her 24-day Maiden Voyage from the Builders' Yard on the Clyde.

[*Photo : Press Photo Service, Cape Town.*

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INTRODUCTION.

As far back as early 1944 it became clear that through the impact of World War II the South African fishing industry had received an impetus that in the immediate post-war years would show expansion at hitherto unprecedented rates, not only of all its existing phases but also in many new directions, with consequent vastly increased exploitation of the available marine resources.

To keep in step with these developments it was decided to take action in an appropriate manner to improve the existing facilities of the Division of Fisheries for research work at sea.

R.S. " Africana ", the larger of the two research vessels operated by the Division, built in financially stringent circumstances and commissioned in 1930, was now (1944) fourteen years old, and, under current and future conditions, after yeoman service of a strenuous character, consisting of nine years of fisheries research and hydrographic survey work and five years of war service as a minesweeper with the South African Naval Forces, had outlived her usefulness.

Pursuantly, under instruction from the Director of Fisheries, basic plans and specifications for a new research ship to replace R.S. " Africana " as early as possible after the cessation of hostilities were drawn up by Mr. J. H. Simpson, A.M.I.N.A., A. I. Mar. E. (at that time as a Lieutenant (E), Staff Officer (Construction) on the staff of the Director, South African Naval Forces), assisted by the authors (all of whom were at that time officers in the South African Naval Forces).

Subsequently, after Treasury approval for the estimated expenditure involved had been granted, enquiries regarding construction made in the United Kingdom, United States of America, Canada, Holland and Sweden immediately after the cessation of hostilities, produced negative results from all except the United Kingdom.

In 1947, therefore, tenders were called for in the United Kingdom, in response to which nine offers were received. In November, 1947, the contract for building was placed with Messrs. A. & J. Inglis, Ltd., Shipbuilders, Pointhouse Shipyard, Glasgow, who submitted the most favourable tender.

Early in 1948, final plans and specifications, derived from the original basic requirements by the builders' Chief Draughtsman in consultation with the authors, were completed and approved, and the keel was laid on 7th April, 1948.

In spite of numerous supply difficulties the builders were able to adhere to their contract period of twenty-one months with the result that the vessel was launched, and named " Africana II " on 10th October, 1949, by Mrs. Leif Egeland, wife of the High Commissioner for the Union of South Africa in London, completed satisfactory trials, and was taken over on 27th January, 1950, sailed from the Clyde on 28th January, 1950, and arrived at Cape Town on 22nd February, 1950, after an uneventful voyage of twenty-four days, a 24-hour stop only at Las Palmas for refuelling being made, manned by the major part of her permanent complement.

CONSTRUCTION AND DESIGN.

The vessel has been constructed to Lloyds' Classification 100 AI steam trawler, and in addition meets all the requisite British Ministry of Transport requirements for vessels sailing under " Foreign-going Articles ".

The principal dimensions of the vessel are—

Length, overall.....	205 ft. 6 in.
Length, between perpendiculars.....	185 ft.
Breadth, moulded.....	33 ft.
Depth, moulded.....	17 ft. 6 in.
Tonnage, gross.....	882
Tonnage, net.....	249
Tonnage, displacement....	1,300

Her speed on trials (mean of four runs) was 12·75 knots, but a speed of 13·5 knots is readily attained.

The appearance and design of the vessel are illustrated in the frontispiece and in Plates I, II and III. She is of trawler type, somewhat similar to the latest large trawlers being built for the Icelandic Government, but with approximately two feet more beam and a larger raised poop, engine-room and boiler-room casing and bridge structure. This raised structure is carried right aft to the counter. The soft-nosed stem is raked, giving a cutaway fore-foot and good steering qualities. The fore-body of the vessel is well flared out above the waterline and ensures a dry fore-deck for working on in bad weather. The stern is of cruiser type. The rudder is of heavier construction and of larger area than normal and gives good steering qualities at very low speeds.

There are six transverse bulkheads, three being oil-tight and three water-tight.

The exposed, i.e. the main, poop or boat and bridge decks are of steel sheathed with Peroba de Campos wood. The lower and internal decks are of steel covered with composition, except those of the wheelhouse and laboratories (Peroba de Campos wood over steel) and boatswain's and scientific stores (pitch-pine). The forecastle-head deck and the deck over the engine and boiler rooms are of steel unsheathed.

Twelve-inch bilge keels are fitted for seventy-four feet of the length, and the bar-keel is of $7\frac{1}{2}$ in. $\times$ $1\frac{5}{8}$ in. steel plate.

The main deck is protected by a continuous 3 ft. 6 in. high steel bulwark capped with Tysack steel bulwark capping, which, having an elliptical outboard cross-section, facilitates inboard manipulation of net-gear coming in over the rail. There are nine freeing ports on either side in the main-deck bulwarks, all nine along the port side and the eight after ones along the starboard side being of the open gridded type, measuring 5 ft. $\times$ 9 in. The ninth and forward one along the starboard side is in the form of a square sluice-door, with vertically adjustable closure, sited at the after outboard corner of the fish-ponds, for cleaning offal, etc., off the fore main-deck.

The well-raked funnel, of modern streamlined design, placed just abaft the bridge structure, incorporates a drying room in its after end, access being by means of a steel door on the starboard side.

Two well-raked steel masts, of roughly equivalent height from the trim-line, give a graceful appearance to the ship in general.

All spaces above the main deck are fitted with glass ports, except in the bridge structure where windows are fitted. The net and lamp rooms have no ports and none is fitted below the main-deck level.

Natural ventilation is provided for all compartments. In addition, all compartments on the lower deck and above, with the exception of the net and lamp rooms and steering compartment, are mechanically ventilated and heated throughout by air forced along distributing insulated ductwork, in which heaters are mounted, by centrifugal cased fans driven by electric motors. The heaters are thermostatically controlled, automatically or manually as desired, and are capable of maintaining an internal temperature of 70°F. with an outside temperature of 30°F. The whole of this installation, including an extractor fan unit in the galley, was fitted by Messrs. Richard Crittall Marine Limited. The ventilating fittings in the accommodation spaces are either " Stylojets " or " Stylovents ". The former provide either a " jet " or " diffused " supply of fresh air, as required, and the latter a " diffused " supply.

Electric welding was used extensively throughout, the entire superstructures being of all-welded construction and all hull-plate butts, for example, being welded. With joggled horizontal plate landings and welded butts the hull presents a very smooth appearance, while the superstructure with all welds buffed flush is markedly clean-looking.

Forecastle Deck (Plate II).

This deck is protected by tubular steel railings, the top bar being three feet above the deck. These rails are stepped 13 in. inboard from the ship's side, the 12 in. scupperway being outside the guard-rails. Access is by a wooden (teak) ladder, with aluminium non-skid treads and tubular steel handrails, stepped amidships. This deck carries the steam anchor windlass, an Emerson Walker direct-grip type with two 5-snug cable lifters for $1\frac{7}{16}$ in. diameter cables. With this direct grip, the cable lifter main

wheel and shaft are in each case permanently locked together, forming two separate complete units. For warping, with warp ends on the intermediate shaft, these units are stationary and when "letting go" the anchors, they rotate in the shaft journal bearings, thus eliminating wear in the cable lifter bore. With steam pressure of 100 lb. per sq. in. the duties at the cable lifters and warping ends, respectively, are 6½ tons at 60 ft./min. and 3½ tons at 140 ft./min.

The anchor cable is 1 $\frac{7}{16}$ in. studded steel cable.

The anchors are the stockless type, one of 17½ cwt. and one of 16 cwt., and are carried in hawse pipes well forward on the forecastle head.

Abaft the steam windlass is a steel V-shaped breakwater slightly canted forward from its base, which in heavy weather throws off most of the water shipped over the bows. The space immediately abaft this breakwater is utilised as a mooring-rope storage area, securing being facilitated by numerous spaced eyes welded to the after surface of the breakwater plating.

There is a bull-ring fairlead at the apex of the soft nose and a spectacle fairlead on either side in the eyes of the ship in the fore and aft line with each windlass warping drum. In addition, there is one spectacle fairlead on either side on the after end of this deck. A pedestal roller is fitted on the deck abaft each warping drum of the windlass to give a fairlead from the after spectacle fairleads to each warping drum. One set of 10 in. mooring bollards is placed on either side of the forecastle head in line with the windlass. Either of these bollards can take ropes from any fairlead without fouling.

A floodlight is mounted on the after rail of the forecastle head, the ship's bell is suspended from a stanchion placed at the apex of the breakwater, and a sea-water hydrant with pivoting stand-pipe for cable washing is sited on the midships line forward of the windlass.

Poop Deck and Deck Over Engine and Boiler-rooms (Plate II).

This centre structure, comprising the engine-room and boiler-room casings and poop, is raised eight feet above the main deck and is all on the same level. Athwartships this structure measures 19 ft., except right aft where it extends to the ship's sides.

On this deck right aft on the midships line is placed a Mechan scientific davit, in principle similar to an Admiralty type torpedo davit, incorporating a wire-measuring sheave connected to a Munro metre-recording clock by a gear-box and flexible-cable drive also of Munro make, arranged to work in conjunction with a horizontal Clarke Chapman steam scientific winch sited 16 ft. further forward (Plate VIII, Fig. 2). This winch has twin cyliners of 4 in. bore by 10 in. stroke driving a centre barrel and two warp ends through double purchase machine-cut gearing. It exerts a pull of two tons at 80 ft./min. from the top layer of wire rope with a steam pressure of 180/220 lb. per sq. in. The barrel, accommodating 1000 fathoms of 1 in. circumference wire-rope, is fitted with a disengaging jaw-clutch and screw-band brake, the wire-rope being evenly laid by a hand-operated spooling gear. The engine has piston-type valves with link-motion reversing gear, all controls being grouped at the forward end of the winch so that the operator faces aft to the davit.

Immediately aft of this winch, but slightly to port of the midships line, is fitted a Kelvin electrically-driven sounding machine handling 360 fathoms of $\frac{1}{16}$ in. seven-strand steel wire.

On either side of the winch and close to the ship's sides wooden 12 ft. sailing dinghies with drop keels are fitted in chocks. A single Admiralty type radial davit provides the necessary hoist for each of these boats.

A spectacle fairlead is fitted on either side of the torpedo-davit pedestal and so placed that each one is in the fore and aft line of one of the warping drums of the winch. Between each of these fairleads and the nearest dinghy is placed a pair of 10 inch mooring bollards.

Immediately forward of the port dinghy a normal 24 ft. 6 in. wooden sailing and pulling lifeboat to carry 34 persons is slung in Schat vertical-track gravity davits. In a similar position on the starboard side a 25 ft. 6 in. wooden motor-lifeboat powered by a 12 H.P. Lister two-cylinder four-stroke marine diesel

engine, to carry 34 persons, is slung in Schat vertical-track gravity davits. The lifeboats can be lowered by one man in approximately 10 seconds, and hoisted either rapidly by runners from the ship's trawl winch or more slowly by special handwinches placed just forward of the forward track of each pair of davits. Both lifeboats are fitted with Mills disengaging gear, and are supplied complete with oars, sails, etc., to M.O.T. standard rules. All four boats were built by Messrs. R. D. Lambie of Wallsend-on-Tyne, of best quality larch and are of clincher construction. While the two dinghies do not come under the L.S.A. rules, the two lifeboats comply with these, the motor-lifeboat being Class B and the sailing and pulling lifeboat Class 1 A.

Schat davits were selected as they obviate the necessity for built-out boat decks with the accompanying obstructions on the main-deck bulwarks. The davit tracks are welded direct to the deckhouse sides, occupy a minimum of space and leave the rails completely clear for working trawls and warps overside.

The after mast of tubular steel construction and with normal rigging is stepped seven feet forward of the scientific winch. A floodlight is mounted on this mast to provide illumination over the poop deck. Immediately to port of the mast is sited a large expanded-metal-ventilated vegetable locker of sheet steel.

Situated amidships and between the fore parts of the lifeboats is an all-steel deckhouse entered from its after side through a stout teak door. This provides space for a single-berth sick-bay, flush-panelled in plywood enamelled white except for the deckhouse which is unsheathed, with the necessary medical cupboard, drawers, desk, etc., and has opening off it at its forward end through another teak door a small compartment containing a lavatory and wash-hand basin with running hot and cold water. This space is unlined. The deckhead of this structure is of steel sheathed externally with Peroba de Campos wood. A section of the starboard side of this deckhouse provides a companion-way from the poop deck to the passage-way giving access to the wardroom, engine-room, galley and pantry, and is entered through a stout teak door on the starboard side of the deckhouse.

On the after end of the engine-room casing deck immediately forward of the sick-bay deckhouse and situated centrally is the engine-room skylight. At the fore end of this skylight is the pear-shaped funnel casing flanked on either side at the forward end of the boiler-room casing with teak ladders to the bridge deck above and the main deck below. The boiler-room ventilators sited on either side of the funnel casing and aft of the ladders are strongly constructed to form sampson posts for 12 ft. derricks. The derrick on the starboard side is of tubular steel construction to take up to 1 ton lifts. That on the port side is of wood and primarily intended for gangway lifting and boat-boom purposes. Both derricks are portable and can be stepped in several positions other than those already mentioned, e.g. on either fore corner of the laboratory casing, on the main-deck bulwarks on either side and on the fore or after sides of the fore-mast.

There is a clear gangway on either side of the engine-room casing deck, there being only a few small ventilators here which are placed well to the sides.

The fore end of the boiler-room casing is recessed on either side to provide space for the ladders to the main deck and the steps and entrances to the laboratories.

Guard rails are fitted as necessary on these decks, four openings closed by chains being provided, one on either side of the torpedo-davit pedestal for working gear from this davit over the stern and one on either side of the engine-room casing where the ship-to-shore gangway rests.

On the stern rail near the torpedo-davit pedestal is mounted a floodlight which can be trained down over the stern and provides illumination for night work with over-the-stern gear.

Bridge Structure (Plate II).

The bridge structure is a continuation of the engine and boiler room casing, measuring at its base 27 ft. fore and aft and 19 ft. athwartships. The laboratories are in this structure, their floor being raised three feet above the main-deck level and having stable-type teak doors opening aft on either side on-to the boiler-room casing recess. The three-foot high space underneath the laboratories is a void, and is utilized for the manholes to the

main oil-fuel bunkers directly below and as a passage-way for the majority of the forward domestic fresh and salt-water pipes, trawl-winch steam and exhaust and the main oil-fuel filling lines. Entrance to the void is through a small water-tight steel door in the waist on the port side.

Immediately above the laboratories is the navigating bridge and Captain's quarters. This deck is three feet higher than the boiler-room casing deck, projects 12 in. outboards on either side beyond the laboratories over the main deck and 3 ft. aft of the laboratories over the boiler-room casing deck.

All the windows on this deck measure 21 in. × 18 in. and were supplied by Messrs. Beckett, Laycock & Watkinson, Ltd., some being Beclawat fixed type of aluminium construction and externally glazed with Beclatite patent glazing strip which simplifies the replacement of broken glasses and eliminates the necessity of the usual " keep " frame and screen. The moving windows are Beclawat " Promwat " non-unit type, spray-tight and screw-operated, the screw gear being of bronze and self-lubricating, the universal connection securing the screw gear to the bottom of the glass ensuring smooth and easy operation.

There are four floodlights on this deck, one at each corner, and they can be swivelled in any direction.

Wheelhouse (Plate II).

The wheelhouse occupies the full width of the fore end of the navigating-bridge deck and is 9 ft. 6 in. fore and aft. It has teak doors in both wings opening aft on to a verandah extending round the two sides and after end of this deck. There are eleven windows in the wheelhouse, six to open and the remainder fixed, giving very good light and visibility. Forced-draught ventilation is provided by means of paired " Stylojet " fittings. A teak door placed in the centre of the after bulkhead leads direct into the chart/radio-room. The whole of the interior, except the deckhead which is unsheathed, is flush-panelled in plywood enamelled white.

Positioned in this space are the following main items of equipment:—

(*a*) On the midships line the Sperry Mark E. 1 (Sperry " Minor ") gyro-compass, flanked to starboard by the Robinson engine-room telegraph pedestal connected to its counterpart on the flying bridge, and backed by the steering wheel and special hydraulic pedestal of the Brown Bros. steam-hydraulic steering gear, which, by means of a jointed rod passing through the deck-head can be connected to its counterpart on the flying bridge when desired.

(*b*) Against and on the forward bulkhead the following :—

(i) towards the port wing a 4 ft. 6 in. × 2 ft. 6 in. chart table of light oak with drawer and cupboard under and book-rack attached to its inboard side;

(ii) near the midships line below window level the extension/retraction control mechanism of the Chernikeeff log and the morse-lamp plug, socket and switch;

(iii) above window level, and spaced from port to starboard, an 8-day clock, the Chernikeeff log distance and speed-indicator dials, the Walker electric log repeat dial, the Siemens helm-indicator dial and the Siemens main engine revolution indicator dial;

(iv) a Kent clear-view screen in the fixed window immediately to port of the middle line.

(*c*) Against and on the after bulkhead to port of the chart-room door, a wooden (teak) flag-locker with sextant ready-use racks over, and above this the tell-tales, switches, etc., of the navigation lights, and the gyro-compass transmission unit.

(*d*) On the after bulkhead to starboard of the chart-room door, the Marconi Visagraph (Plate IX, Fig. 3) and Hughes M.S. XXI echo-sounders, the telephone and its switchboard and the Pelorus stowage bracket.

(*e*) On and through the deckhead, the extension tube with reflecting mirror of the Marine Instruments reflector

standard compass sited directly overhead on the flying-bridge deck, the siren and whistle controls, and the voice-pipes to the flying bridge and engine-room.

Chart and Radio Room (Plate II).

This space, measuring 7 ft. 6 in. fore and aft, lies between the bridge verandahs on either side. There is one window on either side of this room, the port one being of the opening type and the starboard one of the fixed type. Both windows are fitted with light-tight roller blinds. Two " Stylojet " fittings provide forced-draught ventilation.

The starboard side of this space is fitted up as a radio-room, the port side being equipped as a chart-room.

The whole of the interior of this space, except the deckhead which is unsheathed, is flush-panelled in plywood enamelled white. A teak door placed in the centre of the after bulkhead leads direct into the Captain's dayroom.

In the radio-room section a continuous bench at normal table height, with a shelved cupboard and also open shelves below, is fitted against the forward and outboard bulkheads. A desk-type chair with floor fastening is placed at this bench.

On the forward bench and against the bulkhead above it is fitted the Marconi " Oceanic " sound-reproducing equipment (Plate IX, Fig. 4) supplying nine loud-speakers in selected parts of the ship and also a loud-hailer mounted on top of the radar hut on the flying bridge above (Plate VI, Fig. 1). News and entertainment items and orders are therefore distributable throughout the vessel. On the starboard bench and in the after outboard corner is fitted the Marconi " Transarctic " transmitter/receiver installation (Plate IX, Fig. 1), remote control from the flying bridge above being provided. On the outboard bulkhead between the window and the " Transarctic " cabinet are fitted an eight-day clock and desk-lamp. On the after bulkhead is fitted an Admiralty-pattern mercurial barometer (with Gold slide) in gimbals.

In the chartroom section the after bulkhead has fitted against it a 7 ft. 3 in. × 2 ft. 6 in. chart-table, with chart-drawers and shelved cupboard under and battened book-shelf, adjustable elbow-jointed bench-lamp and aneroid barometer over. The outboard end of the chart-table is fitted up as a chronometer-cupboard with plate-glass lid. On the outboard bulkhead over the end of the chart-table is fitted the recording dial and moisture traps of the Negretti & Zambra anemometer, the tube-type wind velocity head of which is mounted directly overhead on the flying bridge. On and against the forward bulkhead are fitted the console of the Marconi " Radiolocator " radar installation (Plate IX, Fig. 2), the Sperry " Minor " gyro-compass bearing repeater and the Marconi " Lodestone " direction-finder cabinet, the last being placed on top of a shelved cupboard of convenient height (Plate IX, Fig. 2).

All the furniture in the chart/radio room is of polished mahogany.

Captain's Quarters (Plate II).

The Captain's quarters occupy the remaining space between the verandahs aft of the chart/radio room. The quarters consist of a day-cabin on the starboard side of this space and a smaller night-cabin, with a bathroom/lavatory off it on the after side, on the port side. Each space is provided with two " Stylojet " fittings for forced-draught ventilation.

The day-cabin, which is fitted up as an office and lounge, is flush-panelled in plywood enamelled white, the deckhead being unsheathed, and has two windows of the opening type, both fitted with light-tight roller blinds, in the starboard bulkhead, and a porthole and teak door, the latter leading onto the after bridge-verandah, in the after bulkhead. The fore-end of this space accommodates a large knee-hole desk with office-type chair, glass-fronted bookcase, desk-lamp, eight-day clock, etc. The after end is fitted with an upholstered settee, running round the after outboard corner and 3 ft. × 2 ft. table. The steel bulkhead between the day-cabin and bathroom/lavatory is recessed just abaft the teak door leading into the night-cabin to form a small strong-room in which is fitted the ship's safe at deck level with built-in filing cupboard over. An upholstered easy-chair is provided. The night-cabin flush-panelled in plywood

enamelled white, the deckhead being unsheathed, is fitted with a bunk-bed with drawers under, a large internally-fitted wardrobe, a chest-of-drawers, an upholstered settee with drawers under and a glass-fronted duplicate-key board. The single window in the port bulkhead is of the opening type with light-tight roller blind. All the furniture in the day and night cabins is of polished mahogany. The bathroom/lavatory is unlined, has a floor of non-skid tiles, a fixed window of frosted glass in the port bulkhead and a porthole with frosted glass in the after bulkhead. A shower and wash-hand basin, both with running hot and cold water, lavatory, mirror, toilet-cabinet, towel-rails, etc., are provided.

Flying Bridge (Plates II and VI, Figs. 1 and 2).

The flying bridge occupies the deck above the navigating bridge and Captain's quarters. There is teak cleading topped by movable glass screens round the fore end, the after parts being protected by brass rails. A teak ladder on the bridge after casing slanting to starboard gives access to this deck from the after bridge-verandah. An "operating" platform of Peroba de Campos wood, measuring 12 ft. × 7 ft. and raised 6 in. above deck level, occupies the central forward portion of the flying bridge. On and through this platform are fitted from forward to aft the Marine Instruments reflector standard compass binnacle flanked to starboard by the Robinson engine-room telegraph pedestal, the steering wheel and pedestal and the Sperry "Minor" gyro-compass bearing repeater, complete with azimuth circle on a Pelorus pedestal (Plate VI, Fig. 2). The after central portion of this deck is taken up by a steel radar hut measuring 6 ft. 6 in. × 6 ft. 6 in. × 6 ft. 6 in. and housing the radar transmitter unit. On the roof of this hut are mounted a 4 ft. 6 in. steel column carrying the radar aerial scanner, the loud-hailer and the morse-lamp (Plate VI, Fig. 1). Immediately forward of the radar hut is fitted a large stoutly constructed lead-sheet lined teak locker with water-tight lid containing all the accumulator-batteries for the wireless and related installations. To starboard of this locker and next to the rail is a general-purpose stowage deck-locker of teak. On the port side stepped in the deck and fixed to the rails is a stout teak post carrying the anemometer wind velocity head. In each forward outboard corner of this bridge is fitted a 16 in. high stool of wood providing two raised look-out positions. On the inside surface of the fore-end teak cleading are fitted from port to starboard the following:—

(i) The electric plugs for the Aldis lamp and morse-light tapping key.

(ii) The telephone to the wheelhouse.

(iii) The siren and whistle controls.

(iv) The Siemens helm-indicator dial.

(v) The microphone plug for the loud-hailer and orders system; and

(vi) The wireless remote-control unit.

A small steel platform-bracket projecting forward on the midships line of the flying-bridge accommodates the fixed-loop aerial and pedestal of the "Lodestone" direction-finder.

Main Deck (Plate III).

The main deck below the forecastle head has a wide open entrance, with passage-way leading forward, on the midships line. In the fore end is situated a compartment fitted up as a net-store (described below, see page 24). Access manholes to the fore-peak and chain-locker are in the deck of this compartment. On the port side immediately aft of the net store is a combined lamp-room and ready-use paint store. A 20-gallon paraffin tank, steel lamp-lockers with keeps and bins for paint containers are fitted here. Aft of this space again on the port side is the ratings wash and shower room, with running hot and cold water to the two showers and four wash-hand basins. The deck here is of non-skid tiles and all the necessary hooks, mirrors shelves, towel-rails, etc., are provided. Immediately abaft the net room on the starboard side are three lavatories, two of these being for ratings and one for petty officers. Immediately aft of the lavatories is the petty officers' wash and shower room, fitted out on the same lines as the ratings' wash and shower room, except that there are one shower and two wash-hand basins only. "Stylojet" fittings in pairs for forced-draught ventilation are provided in all the foregoing compartments except the net store and lamp-room. The companionway to the ratings' accommodation on the lower deck is situated along-

side the ratings' wash and shower room and nuderneath the forecastle-head deck. In the centre of the open entrance and underneath the after end of the forecastle-head deck is sited a 3 ft. × 2 ft. 9 in. hatch for access via a steel trunk to the lower boatswain's store on the hold deck. This hatch has a raised steel combing with a steel watertight cover secured by butterfly nuts.

The main deck aft of the forecastle head has been fitted for trawling on the starboard side only. Full-sized commercial gear can be used. There are 12 in. scupper-ways, on both sides of this deck. The length of the fore-deck from the bridge bulkhead to the break of the forecastle is 54 ft., and the distance between the bulwarks and engine-room casing on either side in the waist is 7 ft. A spare bower anchor is stowed against the forecastle bulkhead on the starboard side, a stream anchor being stowed on the port side against the forward-facing part of the poop casing. The standard heavy capacity "Bear Island" trawl-winch, with automatic guiding gear, supplied by Robertson of Fleetward is situated in the normal position just forward of the bridge structure (Plate VII, Fig. 2). The distance from the centre of the trawl-winch drums to the centre of the midships trawling bollards is 31 ft. The winch handles the $2\frac{1}{4}$ in. trawl-warps, 1,000 fathoms on each drum, through three Tyne Metal Co. roller bollards, the midships pair being of special design incorporating a fathom-measuring sheave connected to a Munro recording clock (Plate VIII, Fig. 1). The steel tubular foremast, capable of a 10-ton lift on the fish falls, is stepped 19 ft. aft of the break of the forecastle and is supported by normal rigging and stays. Robustly-constructed steel cross-trees are fitted on the mast. The spread of this allows a conveniently upright purchase from the cross-tree blocks to the trawl-net when the latter is being lifted inboard. Well below the cross-trees are fitted, one on the foreside and one on the after side, two floodlights for lighting up the whole of the foredeck. Well below these again is fitted a 16 ft. steel tubular 1-ton derrick, which can be stepped either on the fore or after sides of the mast. Both gallows are of normal type fitted with Tyne Metal Co., sheaves, and all the normal trawling fittings such as leach-line blocks, towing block, net-stowing platform, fish-ponds, etc., are fitted (Plate VII, Fig. 1). The trawling bollards, gallows and trawl-winch, as also in fact all machinery on the main deck, are stepped on box-section steel platforms welded to the steel deck. This obviates the necessity of piercing the wooden and steel decks. Some five feet forward of the trawl-winch and on the midships line is a steel companionway, with double teak doors facing aft, giving access to the petty officers' accommodation on the lower deck. Forward of this companionway is a watertight hatch giving access via a steel trunk to the scientific store and refrigeration space below the P.O.'s quarters. A hydrological machine with Lucas sounding machine (described below—see page 25) is fitted on the port side of the fore main-deck just abaft the forecastle bulkhead (Plate VIII, Fig. 3). On this bulkhead is fitted a series of slide brackets to hold at eye level a horizontal row of six deep-sea reversing waterbottles. A similar machine, but minus the Lucas sounding machine, is fitted in the port waist just forward and clear of the bows of the lifeboat (Plate VIII, Fig. 4). Slide-bracket stowage for six deep-sea reversing waterbottles is provided on the engine-room casing near this machine. A group of taps supplying air and cold sea-water for live fish tanks is fitted against the port bulwarks some little distance abaft the forward hydrological machine. There is a set of 10 in. mooring bollards on either side in the after waist, with requisite fairleads in the bulwarks, and in addition there is a similar set on the port side of the fore deck abreast the P.O.'s companionway. The whole of the main deck has been kept as clear as possible of obstructions so that ample clear working space is available.

Engine-room Casing at Main Deck (Plate III).

The engine-room casing is larger than is necessary for the engine-room and the extra space has been used for compartments on either side. On the port side at the fore end is a scientific workshop (described below—see page 24), from which a wooden door leads into an engineer's change-room, measuring 7 ft. × 5 ft. 6 in. This latter room is fitted with lockers, wash-hand basin, urinal, etc.; an outboard teak door leads from here direct onto the main deck and an inboard steel door gives access to the engine-room. On the starboard side of the engine-room casing the

forward compartment, measuring 7 ft. 6 in. × 5 ft., is a fan-room housing the ventilation machinery supplying the after parts of the ship. An inboard steel door gives access to the engine-room. Aft of the fan-room is a vermin-proofed provision room measuring 11 ft. × 5 ft., fitted with steel storage bins and the requisite shelving, and also housing a 5 cu. ft. domestic-type Hallmark freezing cabinet. A door from the after end of this compartment leads direct into the pantry. All these spaces are provided with forced-draught ventilation by means of " Stylojet " fittings.

Main Deck Below Poop Deck (Plate III).

A well-equipped galley, measuring 11 ft. × 8 ft. 6 in., is accommodated in the port fore end of this space, a Carron oil-fired range being fitted. Standing-height benches with heavy hardwood tops and cupboards under, steel shelving, stainless steel sink and draining board with hot and cold running water are provided. In addition to natural and forced-draught ventilation, an extractor fan is fitted over the range. The floor is of non-skid tiles. There is a steel serving hatch on to the main deck and a steel door gives access to an internal lobby. On the starboard side directly opposite the galley is a pantry, measuring 8 ft. 6 in. × 5 ft. 6 in., also entered through a door from the lobby. The pantry is fitted up with a double sink and draining board of stainless steel, provided with hot and cold water taps, and all the requisite stowages for crockery, cutlery, etc. The floor is of non-skid tiles. From the fore end of the lobby a steel door gives access to the engine-room. On the starboard side alongside the pantry are placed the accommodation ladders to the poop deck and to the officers' quarters on the lower deck. The after end of the lobby opens into an athwartships passage, at either end of which are stout teak doors leading on to the main deck. The deck of the lobby and passage is of non-skid tiles. Opening from the after side of the passage is a polished mahogany door into the wardroom. This room occupies the full 19 ft. width of the casing and measures 15 ft. fore and aft, is wall-panelled in recessed style in sycamore with polished mahogany strip battens, the deckhead being of flush-panelled plywood enamelled white, and has three portholes on either side. Forced-draught ventilation is provided by four " Stylovent " diffusers. The room is fitted up as a combined diningroom and lounge. The port side has a 6 ft. 6 in. × 2 ft. 8 in. dining-table, seating eight, 5 on chairs and 3 on an upholstered settee, alongside the forward bulkhead, and a lounge area with easy-chairs and a small round table towards the after bulkhead, on and against which is fitted a mantelpiece with mirror over and mock electric fire under (Plate IV, Fig. 1). The starboard side has a 4 ft. 6 in. × 2 ft. 6 in. dining-table seating five, 3 on chairs and 2 on an upholstered settee, alongside the after bulkhead, and a serving area with a 4 ft. sideboard towards the forward bulkhead. All the furniture is of polished mahogany and the linoleum-covered composition deck is overlaid with rust-coloured carpeting. A polished mahogany door on the midships line in the after bulkhead leads into a passage-way running aft. Two polished-mahogany doors open off either side of this passage, those on the port side leading into the Chief Scientist's and Chief Officer's cabins and those on the starboard side into the Chief Engineer's and Fishing Master's cabins. These cabins are flush-panelled in plywood enamelled white, the deckheads being unsheathed. All four cabins are similarly fitted out with bunk-beds with drawers under, fitted wardrobes, knee-hole desks and chairs, upholstered settees, desk-lamps, carpeting, etc., but the Chief Scientist's cabin is somewhat larger than the others and accommodates additionally a chest-of-drawers, easy-chair, eight-day clock, and glass-fronted bookcase (Plate IV, Fig. 2). All the furniture in these cabins is of polished mahogany. Opening from the after end of the passage-way is a door leading into the officers' wash and shower room. This space contains two showers and five wash-hand basins with hot and cold running water, two separate lavatories, and all the requisite toilet cabinets, mirrors, towel-rails, etc. The deck is of non-skid tiles. A hatch to the steering flat below is sited in the fore deck of this compartment. All these cabins and the wash and shower room have paired " Stylojet " fittings for forced - draught ventilation.

Lower Deck (Plate III).

The forward lower deck provides the accommodation space for all the petty officers and ratings. All the living compart-

ments in this space are flush-panelled in plywood enamelled white, the deckheads being unsheathed, and all have both natural and forced-draught ventilation, paired " Stylojets " being fitted. This portion of the lower deck commences immediately aft of the fore peak bulkhead and ends at the forward bulkhead of the main oil-fuel-bunker cofferdam, i.e. from frames 96 to 56. The petty officers' and ratings' accommodation spaces are divided by a transverse watertight bulkhead, the ratings occupying the forward section.

Ratings' Accommodation Space (Plate III).

The nine seamen and three firemen occupy three-berth cabins, the two messmen-stewards sharing a double-berth cabin (line plan incorrectly labelled). These cabins are placed either side of a central passage-way. At the fore end of the passage stowage space for oilskins and dirty clothes is provided on the port side. On the starboard side is a small store shelved and battened for wireless, radar, navigation, etc., spare gear. Rack stowage for empty suit-cases, etc., is provided in a recessed cupboard towards the after end of the passage on the port side. The cabins are roomy and are fitted with tubular-steel bunk-beds, upholstered settees, steel wardrobes and wooden chests-of-drawers. In other respects these cabins are fitted out to the same standards as the officers' cabins, bunk-lights, book-racks, mirrors, towel-rails, bunk-curtains, etc., being provided. The firemen have a separate mess opening off the after end of the passage on the port side, while the seamen's mess is in a similar position on the starboard side. These messes are provided with tables and seating accommodation on upholstered benches for the full complement of each mess at the same time. Vermin-proof food and fitted mess-traps, lockers, water-filters, shelved cupboards, etc., are provided.

Petty Officers' Accommodation Space (Plate III).

This space on the port side contains two double-berth petty-officers' cabins opening off a central T-shaped lobby. The Boatswain and Donkeyman share the forward one and the Cook and Chief Steward the after one. In the after wall of the upper limb of the T are two doors, the port one leading into the fully-fitted Purser's store, housing also the ventilation machinery supplying the forward parts of the ship, and the starboard one opening into the petty-officers' mess fitted out in the normal manner to high standards. On the opposite side of the passage to the forward petty-officers' cabin is a double-berth cabin shared by the Purser and Electrical Engineer, both of whom rank as Warrant Officers and mess in the wardroom. The accommodation ladder to the main deck is in the passage-way along-side the cabin just mentioned. The space on the starboard side outboard of the petty-officers' mess and between the Purser/Electrical Engineer's cabin and the cofferdam is a three-berth cabin occupied by the Leading Seaman, Leading Fireman and Leading Steward (line plan incorrectly labelled). All the furniture in all these cabins is of polished mahogany and the fitments are in every way on a par with those provided in the officers' cabins aft.

Lower Deck Aft (Plate III).

This deck commences just aft of the main engines at frame 22 and runs right aft to the stern. The forward very much larger section contains accommodation for seven officers and a store-room. All the compartments have natural and forced-draught ventilation, the latter by means of paired " Stylojet " fittings. Right aft on this deck is the steering flat, separated from the officers' accommodation by a water-tight bulkhead, immediately forward of which is the store-room stretching right across the ship. There are three cabins on either side of a central passage-way —the port-side ones from forward to aft being a two-berth for Scientific Officers, the Second Officer's cabin and the Third Officer's cabin, the starboard-side ones from forward to aft being a single berth for a Scientific Officer, the Second Engineer's cabin (line plan incorrectly labelled) and the Third Engineer's cabin. All these cabins are fitted up and furnished on lines identical to those for officers on the main deck above. The space beneath the accommodation ladder at the fore end of the central passage-way is fitted up as a linen cupboard. The store-room at the after end is provided with battened shelves and steel bins and is vermin-proofed. Spare bedding, crockery, cutlery, clothing, officers' empty suit-cases,

etc., are stored here. The steering flat contains the Brown Bros., Edinburgh, combined steam-hydraulic and hand-steering gear. The power unit consists of a constant running uni-directional steam engine driving a V.S.G. variable delivery pump, delivering pressure oil to either of two hydraulic cylinders fitted with single-acting rams connected by links to the rudder crosshead. The bridge control is by a special hydraulic pedestal which permits either " power " or " hand " steering without attendance aft. While steering by " power ", the bridge pedestal operated by the hand wheel delivers oil to a pair of cylinders controlling the pump. If the steam engine stops for any reason, the oil supply from the steering pedestal is automatically switched to the main cylinders, thus converting the gear to a hand-hydraulic steering gear enabling steering to be continued without interruption. The change from " hand " to " power " automatically takes place when the engine is restarted.

Hold Deck.

The fore peak takes up all the space below the main deck forward of frame 96 and can be used as a ballast tank. Built into the after end of the fore peak and on the same floor level as the lower deck are the self-stowing cable lockers. The space beneath the lower deck between frames 96 and 76 is the Boatswain's store. The flooring here is of loose wooden planks; tiered stout shelving, battened as requisite, with bins below, are fitted right round this compartment. A large built-in lock-up cupboard for special items and numerous overhead hooks welded to the beams are provided. The forward and after bulkheads of this space are both watertight divisions. Below the lower deck between frames 63 and 76 are two wing-tanks each of 30-tons capacity for fresh water. The space between these wing-tanks accommodates the scientific storeroom and freezing chambers (described below—see page 24). The bulkhead at frame 62 is oil-tight and there is a coffer-dam between this bulkhead and the two fresh-water wing-tanks. The space under the lower deck between frames 55 and 62 is divided longitudinally into three ballast or oil-fuel tanks, the capacity of each tank being approximately 33 tons salt water or 29 tons oil fuel. The whole space below the main deck between frames 55 and 44 is divided longitudinally into four tanks of equal capacity constituting the main oil-fuel bunkers with a total capacity of 289 tons. The engine and boiler rooms occupy the whole area between frames 18 and 44 (described below). The shaft tunnel between frames 9 and 18 has a 12½ ton fresh-water boiler-feed-tank on either side. The space below the lower deck from frame 7 right aft is a ballast tank.

Engine Room (Plates II and III).

The engine-room is continuous with the boiler-room, there being no dividing bulkhead between the two, and, excluding the shaft tunnel, the space measures 48 ft. fore and aft.

The main propelling installation consists of a set of single-screw triple-expansion reciprocating engines designed and built by Aitcheson Blair Ltd. of Clydebank. Particular attention has been paid to bearing surfaces, which are specially large to ensure the machinery working for long periods without adjustment. The cylinders of the main engines are 16 in., 27½ in. and 74 in. diameter, respectively, having a common stroke of 32 in. Normal development is 1300 H.P. at 120 r.p.m. with a speed of 13·25 knots. The Yarrow-Schlick and Tweedy system of balanced cranks is incorporated. There are no pumps worked off the main engines, all pumps being independent. These independent pumps comprise the following:—

(*a*) Two Weir's boiler-feed pumps.
(*b*) Two Wallsend-Weir fuel-oil pumps.
(*c*) One Drysdale condenser pump.
(*d*) One Dawson & Downie duplex vertical ballast pump.
(*e*) One Dawson & Downie vertical general service pump.
(*f*) One Weir's monotype air pump.
(*g*) One Weir's fuel-transfer pump.
(*h*) Worthington & Simpson salt and fresh water pressure pumps.

An independent surface condenser is fitted, the cooling surface being 1,450 sq. ft., the number of tubes 1,000 and the length overall 8 ft. It is capable of maintaining a vacuum of 27 in. of mercury at 68° F. " Blairs " exhaust steam spreaders are arranged at the throat of the cylinder induction entrance.

The propellor line-shafting has been forged of heavy construction. The stern-tube is Babbit-metal-lined and the propellor shaft revolves in oil. The lubrication of the screwshaft and bearing within the stern-tube is controlled by gravity oil feed at constant pressure. As a protection for the screwshaft the well-known "Newark" oil-retaining gland manufactured by Ferguson Bros., Port Glasgow, is fitted. The intermediate engine shafting (coupled in three sections) is supported by two Michell self-lubricating plummer blocks, pivoted type, and one Cooper self-adjusting bearing. The four-bladed propellor, cast in Stone's manganese bronze, is specially designed for trawling or speed.

Lifting gear is provided in the engine room, as also large tanks for the storage of lubricating oil and diesel oil for the oil-fired galley range and the diesel-engined generator.

Steam is supplied from one single-ended return tube multi-tubular three-furnace oil-fired boiler made and supplied by Rowans of Finneston, Glasgow. The diameter is 17 ft. 6 in., the mean length 11 ft. 6 in., and it is capable of generating 26,000 lb. of steam per hour. Working pressure is 220 lb. per sq. inch, total heating surface 3,800 sq. ft. weight of water 36 tons, and fully loaded weight 125 tons. Circulation is promoted by Hoskis automatic circulator fitted externally and McMaster "Thermco" feed-water circulator fitted internally. Alexander's vortex supreme steam separator is also provided. Clyde Diamond blowers are fitted to each combustion chamber to keep the smoke tubes clear of soot.

The oil-burning installation is of the Wallsend-Howden type working in conjunction with Howden's forced-draught system operating with pre-heated air supply. The following data are an extract from the engine-room log recorded during the maiden voyage from the Clyde to Cape Town:—

I.h.p. 1000, r.p.ms. 104, speed 11·75 knots, oil pressure 100 lb. per sq. inch, oil temp. at heaters 240°F., at burners 220°F., spec. grav. of oil 0·957, calorific value 18,500 B.T.U.'s, size of diaphragms in use No. 18 port and starboard furnaces No. 16 centre furnace, daily consumption 9·72 tons, fuel consumption 0·89 lb. per i.h.p. per hour.

The large bunker capacity, 375 tons with main and reserve bunkers filled, gives the ship a range of approximately 9,500 miles or 38 days steaming at an economical speed of 10 knots. The oil-fuel tanks are fitted with the usual wash plates, are arranged to give a slight fall in the direction of the sludge and drainage connections, and are fitted with steam-heating coils and pneumercator tank gauges.

Messrs. Telford, Grier & McKay, Ltd., Govan, Glasgow, were responsible for the entire electrical installation. The electrical power-plant consists of two independent generating sets. The larger set is capable of supplying power for the whole of the electrical equipment in the ship, the smaller set is intended for harbour use and general service, when calls on power are smaller. The larger generator has an output of 40 kW. at 220 volts, is of Laurence Scott make and coupled to a Reader high-speed compound steam engine. The smaller generator of Crompton Parkinson make, coupled to a 160 h.p. Lister diesel engine, has an output of 21 kW. at 220 volts. Both units are arranged to feed the main switchboard from which the whole system is controlled. The large switchboard, of the enclosed type, is fitted on a railed-in steel platform in the after starboard corner of the engine-room over the generating sets, the larger part of this platform being fitted up as an engineer's workshop with electrically-driven lathe, drilling machine and double-wheel grinder, etc. All parts of the switchboard, both back and front, are readily accessible. Between the boiler and the ship's side on the starboard side and at a raised level is an engineer's store partitioned off by half-steel bulkheads and expanded wire netting. This store is fitted with the requisite shelves, lockers, etc.

Below the checker-plate flooring of the engine-room, and between the main engines and the boiler front, are placed the two hull fittings of the Hughes M.S. XXI echo-sounder, and also the after and port projector/receiver unit of the Marconi "Visagraph" echo-sounder. In addition to the various pumps installed in the engine/boiler room space and already enumerated on page 16 above, the following units are also fitted in this space—

(i) a small electrically-driven (Laurence Scott motor) compressor pumping air into a compression tank connected to the air-supply taps in the laboratories

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and on the port bulwarks on the fore main deck ;

(ii) an electrically-driven earthenware pump of Hathenware make, connected by means of hard-rubber-lined pipes to the sea-water taps in the laboratories and on the port bulwarks on the fore main deck ;

(iii) a small-heated still of Davie & Horne make to provide distilled water for general scientific purposes and for accumulator-batteries maintenance. The cooling of this still is by sea water, but the water distilled is from the ordinary fresh-water supply.

SPECIAL ACCOMMODATION AND RESEARCH.

Biological and Hydrological Laboratories.

The scientific laboratories are accommodated in the bridge superstructure in the space between the forward bulkhead of this structure and the boiler-room casing. Their position is shown in Plates II and III and they are illustrated in Text Fig. 1 and Plate V, Figs. 1 and 2.

The deck of this space is raised three feet above the level of the main deck. Internally this space measures 26 feet fore and aft along the midships line, 18 feet athwartships and 7 feet from deck to deckhead.

The underside of the deck over the boiler-room and the after bulkhead, including the boiler-room recess, in way of the boiler-room casing are insulated, the former more heavily than the latter. The deck is of steel sheathed with Peroba de Campos wood.

Internally the side, forward and after bulkheads and deckhead are flush-panelled in plywood backed by pitch-pine tongue and groove planking on battens, all such panelling being enamelled white. The boiler-room recess projection is flush-panelled in light oak.

Access to the laboratories from the main deck is by means of two stoutly-constructed, stable-type teak doors 2 ft. 6 in. between jambs placed at the outer after ends and opening outwards against the boiler-room casing, which, although elsewhere the same width as the bridge superstructure, is here recessed sufficiently to provide relatively sheltered entrance to the laboratories through the after bulkhead. The top half of each door has a fixed, heavy clear-glass, circular light, provided with a removable darkening screen of wood.

The steps and platform from the main deck to the laboratory doors are of teak framed in steel angle-irons.

Natural lighting of the laboratory space is by means of eleven, 18 in. × 18 in., fixed, heavy clear-glass, Beclawat windows, fitted internally with adjustable, spring-loaded, light-tight roller blinds. Four of these windows are in the port bulkhead, three in the forward bulkhead and overlooking the foredeck, and four in the starboard bulkhead. All the windows are placed much lower than usual, their lower rims being practically on a level with the tops of the working-benches, thus ensuring the best possible light for microscopic and other work.

The laboratories are electrically lighted by ceiling lights, six in the biological section and two in the chemical or hydrological section, and an adjustable bracket bench-lamp of the triple-elbow type at each of the six working places.

Natural ventilation is by means of 5 in. spray-tight torpedo vents, placed just below the ceiling in the side bulkheads, four along the port side and four along the starboard side. Artificial ventilation is provided by five " Stylovent " diffusers placed in the ceiling, four in the biological section and one in the chemical section.

The forward port side of the laboratory space is partitioned off from the remainder, which is the biological laboratory, by means of plywood panelling secured to a wooden framework to form the combined chemical or hydrological laboratory and photographic darkroom. This chemical section measures 12 feet fore and aft along the midships line and 8 feet athwartships. The whole of the partition panelling is enamelled white. A 2 ft. 6 in. door of light oak, hinged at its forward jamb and swinging into the biological laboratory, is placed in the fore and aft partition and provides communication between the two sections. Above this door,

showing in the biological laboratory, is fitted a red-burning warning light controlled by a switch in the chemical laboratory.

All working-bench tops are of teak, and all other wooden furniture fittings, e.g., cupboards, drawers, bookshelves, drawing-desk, racks, etc., of light oak.

A working bench, 3 ft. wide and 2 ft. 6 in. high, is fitted along the port, forward and starboard sides of the laboratory space. On the port side this bench ends 4 ft. 6 in. short of the after bulkhead and on the starboard side the corresponding distance is 3 ft. 6 in. Six working places, each one either opposite or nearly opposite a window, are positioned along this bench—two in the chemical laboratory, one facing to port and one forward, and four in the biological laboratory, one facing forward and three to starboard. The chair at each working place is of the swivel type, with fixed pedestal of metal and frame (with padded leather seat), back and arm-rests of wood.

The bench top in the biological laboratory abaft the thwartships partition is lead-sheet covered, has a median fore and aft U-shaped channel spilling into a sink placed near the forward end of this bench, and a marginal beading 1 in. high all round. At the back of this bench next to the bulkhead is placed a row of six, spaced six inches apart, two-way, straight, ebonite, laboratory water taps supplying cold sea water, and immediately above them another row of seven, spaced six inches apart, two-way, straight, metal, laboratory gas taps supplying air, the air-supply taps being sited to come midway between adjacent pairs of sea-water-supply taps. Above but forward of these taps and in line with the sink is fitted a wooden rack to hold four 10-litre glass aspirators, their taps protected by a wooden guard-rail, for diluted formalin and alcohol. Abaft this rack, but at a higher level, is placed a wooden rack to hold, one ahead of the other, two 10-gallon earthenware containers, each with tap and screw-type filling cap, for concentrated formalin and alcohol. These containers are filled via deck fittings, incorporating filters, placed in the bridge verandah deck above close to the bridge-house casing. The glass aspirators can be gravity-flow filled from these containers by rubber-tube connections between the taps of the latter and the top inlets of the former. On this bulkhead is also fitted three water-tight electric plugs, sockets and switches.

All sinks are of pressed stainless steel and have centrally-placed outlets at one end. There are eight sinks in all, six measuring 19 in. × 14 in. each, and two measuring 24 in. × 15 in. each. Each working place has one of the smaller sinks fitted conveniently to the right, while one of the larger sinks is placed near the forward end of the port-side lead-sheet-covered bench in the biological laboratory, and the other near the after end of the port-side bench in the chemical laboratory. At each of these larger sinks wooden, pegged, draining boards are fitted. All six smaller sinks are provided with wooden covers, with finger-rings for lifting, fitting flush with the bench tops.

At each of the larger sinks are fitted the following:—

(*a*) One one-way, swan-necked, metal, laboratory water tap supplying cold fresh water.

(*b*) One one-way, swan-necked, metal, laboratory water tap supplying hot fresh water.

(*c*) One one-way, straight, metal, laboratory vacuum tap connected to the main and auxiliary condensers in the engine-room.

At each of the smaller sinks are fitted the following:—

(*a*) One one-way, swan-necked, metal, laboratory water tap supplying cold fresh water.

(*b*) One one-way, swan-necked, ebonite, laboratory water tap supplying cold sea water.

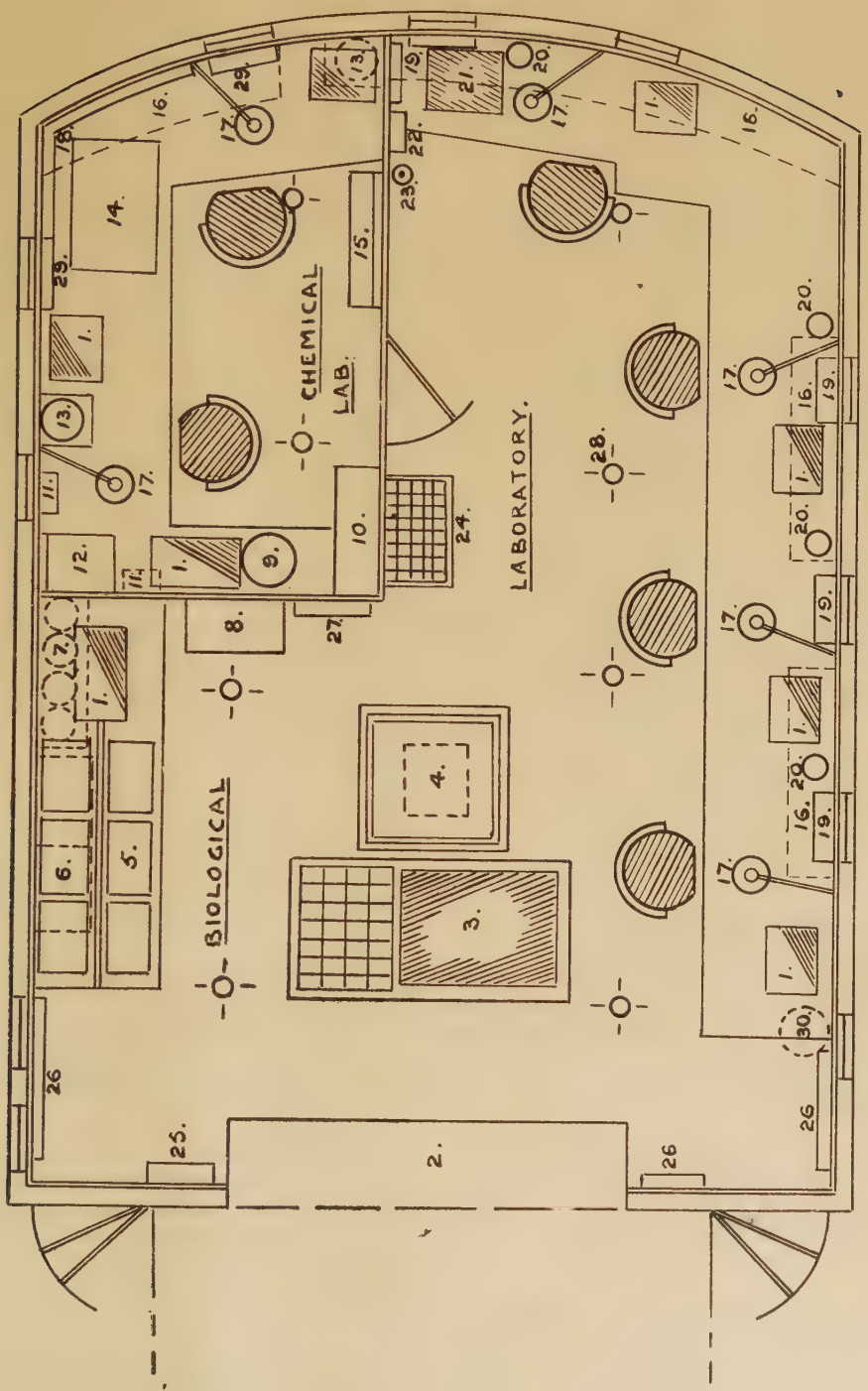
(*c*) One one-way, swan-necked, metal, laboratory gas tap supplying air.

The cupboards and drawers fitted under the working benches are so arranged as to provide knee-hole desk facilities at each working place, a tier of drawers being placed to the right and a cupboard to the left of each worker. In the bench top, and flush with it, over a cupboard to the left of the forward working place in the biological laboratory, is fitted a 21 in. × 18 in. sheet of plate glass, finely ground on its underside, and electrically lit from below, for which

TEXT-FIGURE I.

PLAN OF LABORATORIES.

1. Sinks.
2. Pigeon-holed rack.
3. Drawing desk.
4. Double-decker gimballed table.
5. Six glass aquaria on lead-sheet-covered bench.
6. Two 10-gal. earthenware containers for alcohol and formalin.
7. Four 10-litre aspirators.
8. Dish rack.
9. Five-gal. distilled-water tank.
10. Chemical cupboard.
11. Darkroom lamps.
12. Draining and drying rack.
13. Twenty-litre aspirators.
14. Gimballed table.
15. Pigeon-holed rack.
16. Bookshelves.
17. Adjustable bench-lamps.
18. Deep-sea thermometer rack.
19. Specimen-tube rack.
20. Gimballed tables.
21. Ground-glass inset lit from below.
22. Loudspeaker.
23. Telephone.
24. Chest-of-drawers.
25. Rifle rack.
26. Specimen-tube racks.
27. Rack for measuring cylinders.
28. Ceiling lights.
29. Test-tube racks.
30. Electrically-heated still.



TEXT-FIGURE I.

purpose the cupboard is appropriately fitted out. A separate switch to control this cupboard light is placed on the bulkhead forward of the glass plate. Below this cupboard are two shallow drawers. Between this cupboard and the fore and aft partition is fitted a tier of small drawers to take 8 in × 5 in. filing cards. All the other cupboards under the working benches are fitted with shelves with front-edge beadings. The tier of drawers under the after end of the port-side lead-sheet-covered bench in the biological laboratory is baize-lined. The drawer-chest against the fore and aft partition, immediately abaft the communicating door, has six baize-lined drawers in two tiers of three each. The top of this chest is provided with removable fiddels standing 3 in. high dividing the surface into 3 in. squares. All drawers facing thwartships are provided with hinged, vertical keep-battens.

Above window level in both laboratories are single-tiered bookshelves. In the biological laboratory these are continuous from the fore and aft partition along the forward and starboard bulkheads for the full lengths of the working benches, being interrupted only along the starboard bulkhead by the torpedo-vent ventilator openings. In the chemical laboratory the book-shelves run along the forward bulkhead only from the inboard margin of the forward window to the port corner. Across the fronts of the bookshelves are fitted removable, horizontal keep-battens. The bases of the bookshelves are in two halves with a ½ in. wide intervening slit throughout their lengths. This median slit is left to pass wingnut-headed screw-bolts screwing into the bottoms of wooden book-ends, made movable in this fashion to fix in any desired positions along the bookshelves, and thus prevent undesirable movement of books with motion of the ship.

On the bulkhead at each working place are fitted two electric plugs, sockets and switches and, similarly, in the biological laboratory only, a gimballed swing-table 6 in. in diameter with raised rim.

In the biological laboratory against the after bulkhead between the two entrance doors and over the boiler-room recess, is placed a wooden bottle-rack measuring 9 ft. athwartships, 4 ft. high and 12 in. deep. This bottle-rack consists of one horizontal row of 3 in. square, over two horizontal rows of 4 in. square, over two horizontal rows of 5 in. square, over two horizontal rows of 6 in. square, felt-lined pigeonholes, inclined at an angle of 20°, to hold specimen jars, etc.

On the midships line and in the centre of the full-width portion of the biological laboratory are placed a wooden drawing desk and a metal double-decker swing-table on gimbals. The drawing desk measures 6 ft. × 3 ft., its length being athwartships. The 4 ft. × 3 ft. section of its top towards the starboard side has inset flush with the surface a sheet of plate glass, finely ground on its underside. Below this the desk is fitted with four shallow chart drawers facing aft, except the topmost space, immediately below the plate glass, which is open-fronted and fitted out as an illumination space for lighting-up the plate-glass sheet from below. The control switch for the electric lights in this space is placed conveniently to hand near the front of this space. A portable drawing stool of suitable height with padded leather seat is provided. The 3 ft. × 2 ft. section of the top of the desk towards the port side is plain, but fitted with removable fiddels standing 3 in. high dividing this surface into 6 in. squares. Below this the desk is fitted out as a cupboard, with double doors facing to port and removable, vertically adjustable, plain shelves over which are removable, vertically adjustable, pierced shelves to take a variety of sizes of glass containers, etc. The gimballed table is of stainless steel, the upper traylike deck measuring 3 ft. × 3 ft. and the similar lower one 18 in. × 18 in. The guard-rail, slightly above the level of the upper deck, and the vertical supports are also of stainless steel. All other parts are of ordinary steel painted in aluminium. The weight, slung close to the deck below the table, weighs 56 lb.

In the after starboard corner of the chemical laboratory is placed a chemical cupboard with double doors opening to port, fitted out internally with pierced shelves over plain bases to take a variety of sizes of chemical containers, and with its top divided into squares by wooden fiddels to hold large-sized chemical containers.

On the fore and aft partition, and immediately to the right of the forward working place in the chemical laboratory, is fitted a bottle-rack in the form of eight horizontal

and eight vertical rows of 3 in. square felt-lined pigeonholes, inclined at an angle of 30°, to hold sea-water sample bottles, etc.

In the chemical laboratory the space along the after partition between the chemical cupboard and the port working bench is filled in with an 18 in. wide working bench, the outboard section of which is occupied by a large-sized sink, and the inboard part holds a 5-gallon copper distilled-water storage tank, a tier of baize-lined drawers being fitted below. The remaining portion of this bench top, as also the after end of the port working bench are lead-sheet covered and with 1 in. high marginal beading all round.

The forward end of the port-side working bench in the chemical laboratory incorporates a 34 in. × 22 in. swing-table on gimbals, the top of which is surfaced with finely ribbed rubber sheeting.

On the bulkheads and working benches in both laboratories is fixed a great variety of fitments and special items of equipment. The more important of these are the following:—

(*a*) In the chemical laboratory—

(i) over the port-side window a wooden rack to hold a 20-litre glass aspirator;

(ii) in the forward starboard corner, at a height about level with the top edge of the forward window, a wooden rack to hold a 20-litre glass aspirator;

(iii) in the after port corner an overhead wooden draining and drying rack in the form of a shelf pierced with a large number of 2 in. diameter holes;

(iv) on the port bulkhead, just forward of the draining and drying rack, a photographic darkroom safe-light, and a similar safe-light on the after partition in line with and over the large sink;

(v) around the forward port corner, below the bookshelves, one wooden rack on the forward bulkhead to hold eighteen deep-sea thermometers and a similar rack on the port bulkhead;

(vi) wooden racks, of special designs, in various convenient positions to hold measuring cylinders, flasks, burettes, reagent bottles, test-tubes, etc.

(*b*) In the biological laboratory—

(i) on the thwartships partition a wooden rack, of special design, to hold glass basins, dishes, etc., of various sizes;

(ii) on the fore and aft partition, abaft the communicating door and over the dresser-chest, an 8 in. dial, eight-day wall clock, with long centre second hand, and immediately below it a glass-fronted key-board;

(iii) on the fore and aft partition and clear of the swing of the communicating door, a loud-speaker connected to the sound reproduction installation in the radio-room above, and immediately below it a telephone connected to the exchange in the wheelhouse above;

(iv) wooden racks, of special designs, in various convenient positions to hold measuring cylinders, flasks, re-agent bottles, specimen tubes, etc.;

(v) on the starboard bulkhead above the after end of the working bench an electrically-heated still delivering chemically-pure distilled water, more particularly required for salinity, phosphate, etc., analyses. The cooling of this still, as also the water distilled, is from the ordinary fresh-water supply, the cooling-circulation waste being piped back to the hotwell in the engine-room for re-use.

To prevent movement, with motion of the ship, of apparatus and equipment while in use, microscope cases are screwed to bench tops, microscope stands are arranged for clamping to metal plates countersunk in bench surfaces, retort stand uprights are screwed into metal holders countersunk in bench surfaces, and so on.

Scientific Store and Refrigeration Space (Plate II).

This space on the hold deck measures approximately 24 ft. × 16 ft., about half of it being given up to the ship's cold chambers, the experimental quick-freezing cabinet, and the machinery for both, the other half being fitted up as a scientific store with tiers of shelves suitably battened.

The cold chambers, the experimental quick-freezer of the cold-blast type, and the relevant machinery were manufactured and fitted by Messrs. J. & E. Hall, Ltd., Dartford, Kent. The cold rooms, with a total capacity of 350 cu. ft., are capable of carrying a complete month's supply of fresh meat, provisions and vegetables for the full ship's company.

The hull below the floor of this space is suitably pierced to house on the starboard side the forward projector/receiver unit of the Marconi " Visagraph " echo-sounder, and on the port side the Chernikeeff log.

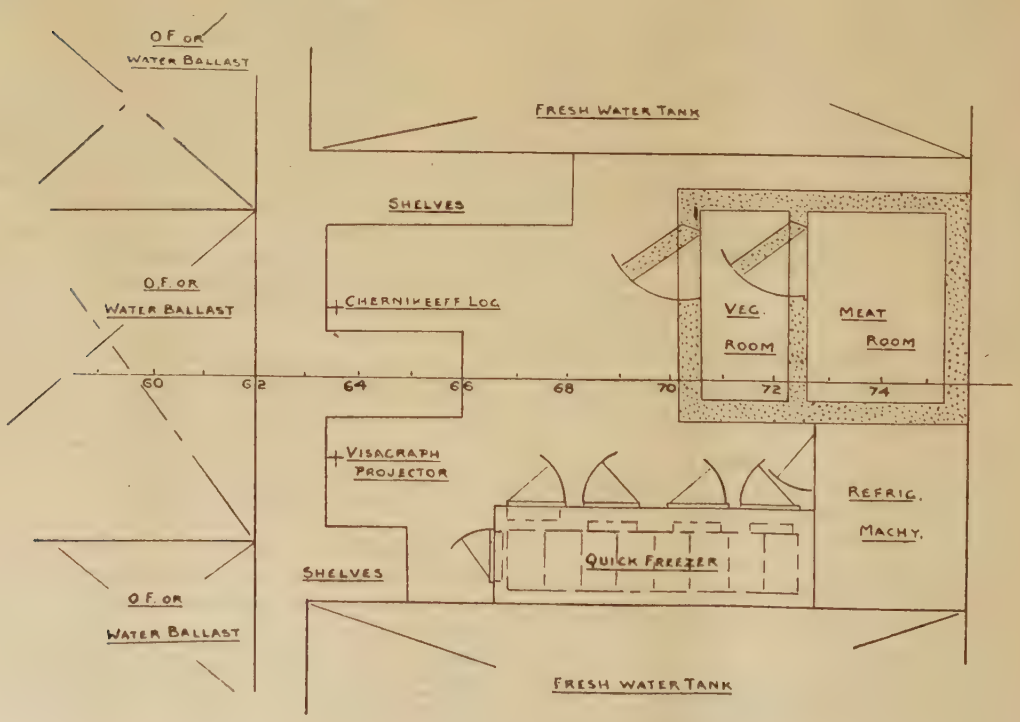
Net Store (Plates I and II).

This store underneath the fore part of the forecastle head has double steel doors opening aft on to the central passage-way and open entrance. It is heavily shelved and battened, with strong bins below the shelving. Numerous heavy hooks are welded to the deckhead. The deck is of steel. Fully-roped and unroped trawls can be stowed on the shelves, and the bins are used for stowing blocks, shackles, swivels, etc., required as trawling, dredging, etc., equipment. Part of the shelf space is specially segregrated for the stowage of plankton nets, and a large lock-up cupboard is provided for special tools and items of equipment. There is a clear lead from the trawl-winch to the interior of this store and heavy nets can therefore be power-hauled bodily on to the foredeck.

Scientific Workshop (Plate III).

This small space in the port side of the engine-room casing measures 9 ft 6 in. ×

TEXT-FIGURE II.



5 ft. 6 in. A work-bench, with shelved cupboards and drawers under, is fitted along the inboard and forward bulkheads. The steel floor is covered with a wooden grating. Part of the work-bench is rigged as a carpenter's bench with appropriate vice, and another part as a metal-worker's bench with appropriate vice of the precision type. The forward bulkhead carries a fitted tool cabinet as also the recording mechanism of the Negretti & Zambra thermograph, the bulb of which is sited in the condenser intake in the engine-room almost directly below. The inboard bulkhead carries a series of twelve slide brackets for the stowage of deep-sea reversing waterbottles.

SCIENTIFIC EQUIPMENT.

The scientific equipment and methods used in " Africana II " are in general substantially similar to those employed in " Discovery II ", " Ernest Holt " and other ships carrying out comparable work.

Deck Gear.

The only deck gear requiring further descriptive elaboration are the two hydrological machines fitted along the port side (Plate VIII, Figs. 3 & 4) and the equipment for handling gear of various kinds over the stern (Plate VIII, Fig. 2).

Essentially, each hydrological machine consists of a reel driven by a small steam engine through a clutch and suitable gearing. The reel is 30 in. in diameter, 10 in. in width, with a hub of 4 in., is capable of holding 3,000 fathoms of 4 mm. flexible steel wire, and has cast-steel barrels with bronze spur rings and bronze pinions. A Ferodo-lined band-brake of large surface on the periphery of one cheek operated by a hand lever and ratchet provides control. Hand-operated spooling gear is provided for guiding the wire on to the reel. These reels were made and supplied by Messrs. Ferguson Bros., Port Glasgow, who also provided the drawings for the mounting of the complete units. The steam engines coupled to the reels were made and supplied by Messrs. Reader & Sons, Ltd., Nottingham, and are of twin-cylinder two-crank type, developing 9·8 H.P. at 500 r.p.m. with a steam pressure of 180 lb. per sq. in. At the forward machine the engine is forward of the reel, but at the after machine the positions are reversed. The forward engine also drives a Lucas sounding machine, this machine being bolted to a small steel platform at bulwarks' level forward of the engine, and is driven by means of a belt over a pulley on the forward-extended crankshaft of the engine. The pulley can be engaged or otherwise by means of a sliding clutch on the shaft. The davits used in conjunction with the reels, of special design and construction, were made by Messrs. R. & W. Munro, Ltd., London. They are stepped close to the bulwarks in the centre line of the reels and outboard of them. Each davit consists of a tubular-steel post 14 ft. high with a horizontal derrick arm 7 ft. in length. A steel strut from the centre of the post to the outer end of the derrick arm gives the necessary strength and rigidity. A tubular steel stay attached to the outer end of the derrick arm is arranged so that the derrick arm can be swung outboard to an angle of 45° from forward or aft and firmly fixed, or the arm can be turned inboard and secured when in harbour. In the outboard positions the wire plumbs 5 ft. 6 in. from the outside of the bulwarks. The wire passes from the reel to a metre-measuring sheave at the top inboard side of the post, thence down to a sheave attached to the heel of a strong spiral spring coiled round a stout rod sited alongside and attached to the post, then up again over a third sheave at the top outboard side of the post and so through a fourth sheave at the outer end of the derrick arm and on down to the water. The metre-measuring sheave is connected by a flexible cable drive to a metre-recording clock, reading to 10,000 metres, clamped on the post at eye-level. The advantages of these special davits lie in the height of the derrick arm above the water, which allows water-bottles, nets, etc., to be hauled up to or above the level of the bulwarks, in the ease with which the dial of the clock can be read, and in the very efficient spring arrangement whereby the shocks of rapidly variable loads are absorbed.

The over-the-stern gear has already been fairly fully described on page 8, but it is of interest to note that the jib of the torpedo-type davit, operated for radial movement by

hand-operated worm and wheel on the pedestal, has adequate height for lifting nets, etc., clear of deck level, that the sheave at the jib end is arranged for vertical lifts as well as for oblique towing, and that the wire from the winch-drum enters the pedestal through a sheave at its base, enabling the hoist to be worked with the jib in any position. The jib in its fully aft position has a 4 ft. offset from the ship's stern.

Sounding Machines.

Although Lucas & Kelvin machines are fitted, sounding is now carried out mainly with the echo-sounding machines. The first-named machines are used only when information regarding the nature of the bottom deposits is required.

For shallower water work the Marconi " Visagraph " echo-sounder is fitted (Plate IX, Fig. 3). The " Seavisa " part of the equipment provides a visual " flash " reading over five depth-ranges, viz. 0–130, 100–230, 200–330, 330–430 and 400–530 fathoms, while the " Seagraph " part provides an accurate, undistorted picture of the contours of the sea-bed upon a continuous roll of specially prepared paper over three depth-ranges, viz. 0–150, 0–300 and 0–600 fathoms. The stylus is of the endless-belt type, and, as it records on the upper-most side of the paper-roller, the observer is unable to see each sounding-mark on the paper at the moment it is made, but in fact has to wait until the roller has turned sufficiently far forward to bring the sounding-marks into view. As mentioned previously on pages 17 and 24, two projector/receivers are mounted in the ship's hull, suitably pierced for the purpose under the floor of the scientific store forward and under the engine-room floor aft. Either projector/receiver may be brought into use at will to suit conditions and directions of sea and swell. On high sensitivity excellent traces of sub-surface schools of fish, more especially pilchards, have been obtained with the "Seagraph" part of the installation.

For deep-water work the Hughes M.S. XXI echo-sounder is fitted. This equipment is purely graphic in operation, providing sea-bed contours upon a continuous roll of specially-prepared paper over nine depth-ranges, viz. 0–800, 500–1,300, 1,000–1,800, 1,500–2,300, 2,000–2,800, 2,500–3,300, 3,000–3,800, 3,500–4,300 and 4,000–4,500.

The stylus is of the centrally-pivoted type and therefore each sounding-mark on the paper is visible to the observer at the moment it is made. To date all attempts to obtain traces of sub-surface schools of fish with this equipment have proved abortive. The projector and the receiver, separate units in this instance, are fitted below the engine-room floor as previously mentioned on page 17. In these instances also the units are fitted inside the hull which is unpierced.

Apparatus.

While strictly-speaking out of context under the above heading, some few remarks are here set down regarding the Marconi " Radiolocator " radar and the Marconi " Lodestone " direction-finder equipment.

The former embodies a 9 in. Position Plotting Indicator and operates on four selective ranges, viz., 1, 3, 10 and 30 miles. The display shows every above-water object in the vicinity of the ship in its exact relative position, the minimum range being 50 yards. The bearing and distance of any such object can be quickly and accurately ascertained by means of the bearing indicator and range marker of the instrument. The installation is shortly to be modified to bring it into line with the improved performance of the Mark IV set recently produced by the makers. In consequence the maximum range will be increased to 40 miles.

The latter incorporates a superheterodyne receiver and improved goniometer combined in one cabinet. A special search coil and automatic quadrantal error corrector render the taking of bearings a process not necessarily demanding the services of a trained radio officer.

The waterbottles (of the frameless type for reversing purposes), plankton nets, release gears, dredges, trawls, etc., are mostly similar to those used by ships carrying out comparable work in various parts of the world, but some few modifications, mainly to facilitate handling, assembly and dismantling, have been introduced both in apparatus and methods. For example, the three sinker-weight wires of vertically-rigged plankton nets are not seized to the spacing ring and eyes of the bucket, but are attached by means of small brass clamps readily

detachable or otherwise by a single butterfly-headed screw-bolt.

On the hydrological side extensive use, with excellent results, is being made of two bathythermographs of Wallace & Tiernan make, the one having a depth-range of 0–450 ft. and the other of 0–900 ft.

All the thermometers used, reversing (both protected and unprotected types), Nansen-Petterssen type for insulated water-bottles, and surface, are of Negretti & Zambra make, the insulated waterbottles being made and supplied by Messrs. Elliot & Garrood of Beccles, Sussex.

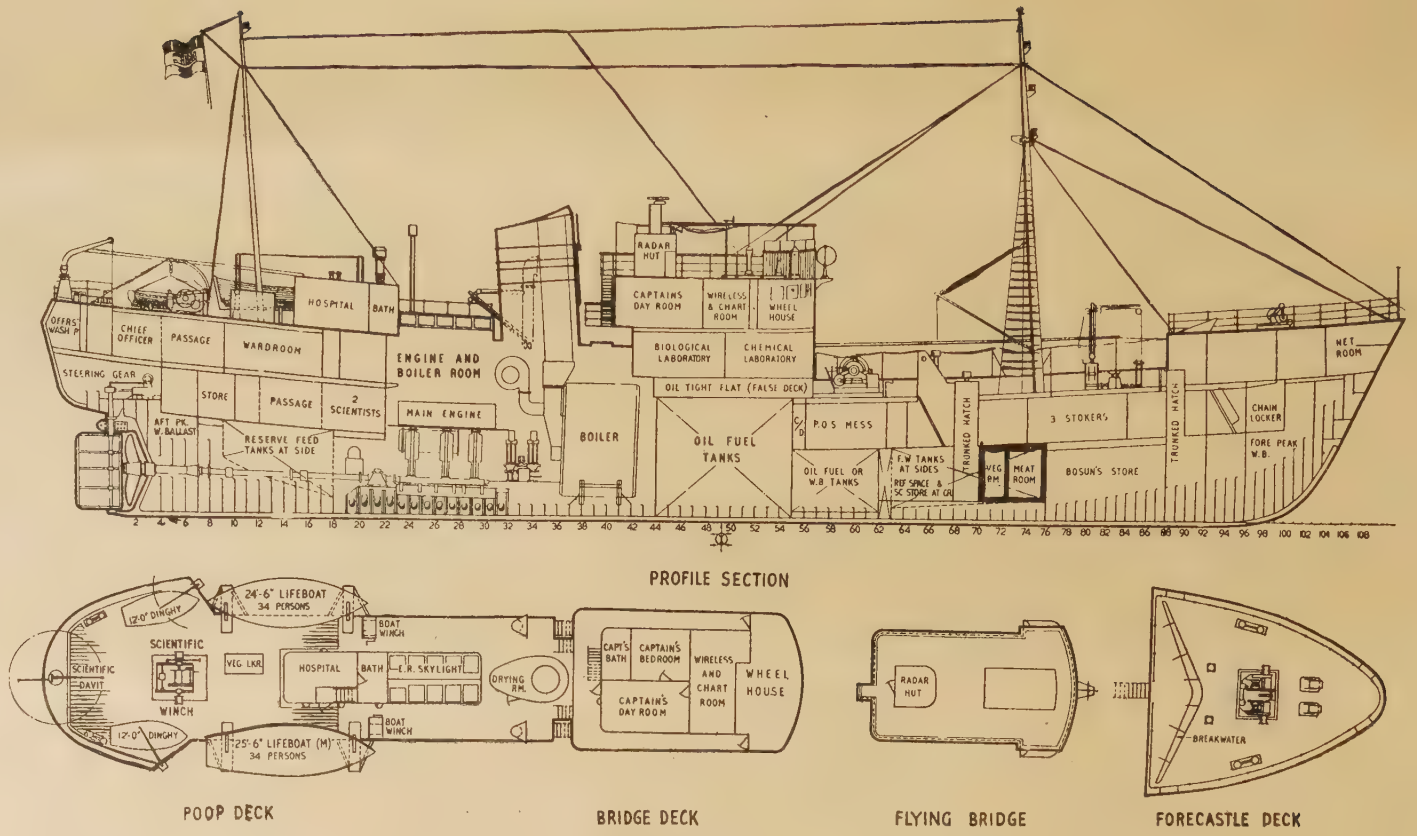
[Plates I – IX.]

PLATE I.

F.R.S. "AFRICANA II" ON SEA TRIALS IN THE FIRTH OF CLYDE, 26TH JANUARY, 1950.
Photo: James Hall, Ltd., Greenock.

PLATE II.

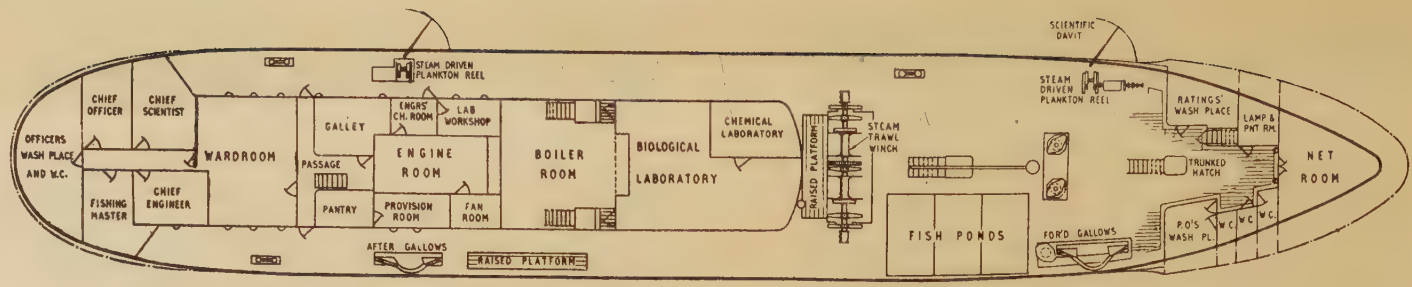
FISHERIES RESEARCH SHIP "AFRICANA II".



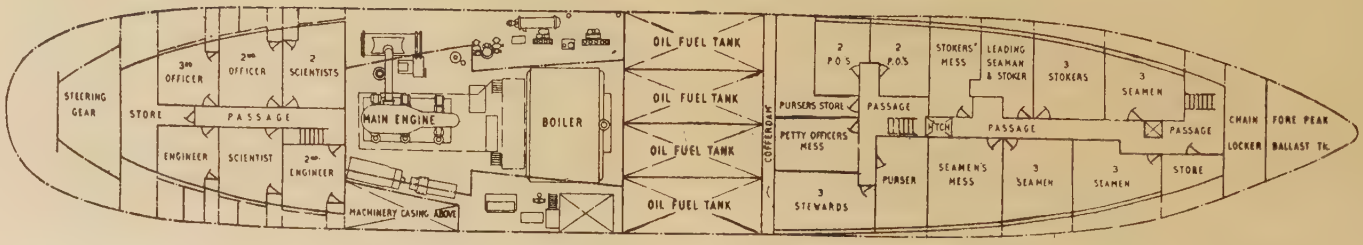
PROFILE SECTION AND PLAN OF POOP, BRIDGE, FLYING BRIDGE AND FORECASTLE DECK.

[*Reproduced from* "The Shipping World" *of March* 22, 1950.

Plate III.



MAIN DECK



LOWER DECK

Plans of main and lower decks.

[*Reproduced from* "The Shipping World" *of March* 22, 1950.

PLATE IV.

FIG. 1.—WARDROOM, LOOKING TO PORT.

FIG. 2.—CHIEF SCIENTIST'S CABIN, LOOKING INBOARD.

[Photos: James Hall, Ltd., Greenock.

PLATE V.

FIG. 1.—BIOLOGICAL LABORATORY, LOOKING FORWARD.

FIG. 2.—BIOLOGICAL LABORATORY, LOOKING AFT.

[*Photos : James Hall, Ltd., Greenock.*

PLATE VI.

FIG. 1.—VIEW ON FLYING BRIDGE LOOKING AFT, SHOWING RADAR HUT, WITH RADAR SCANNER, LOUD-HAILER AND MORSE-LAMP FITTED ON TOP. [*Photo : James Hall, Ltd., Greenock.*

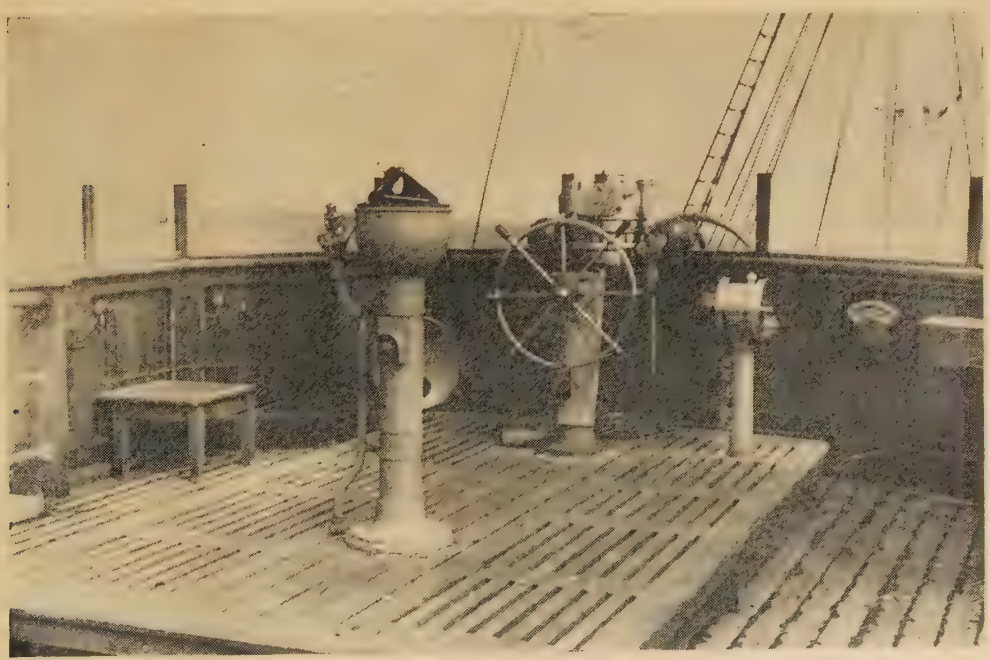


FIG. 2.—VIEW ON FLYING BRIDGE LOOKING FORWARD AND TO PORT. [*Photo: J.M.M.*

PLATE VII.

FIG. 1 — STARBOARD SIDE OF FORE DECK, SHOWING FORE GALLOWS AND FISH-POND.

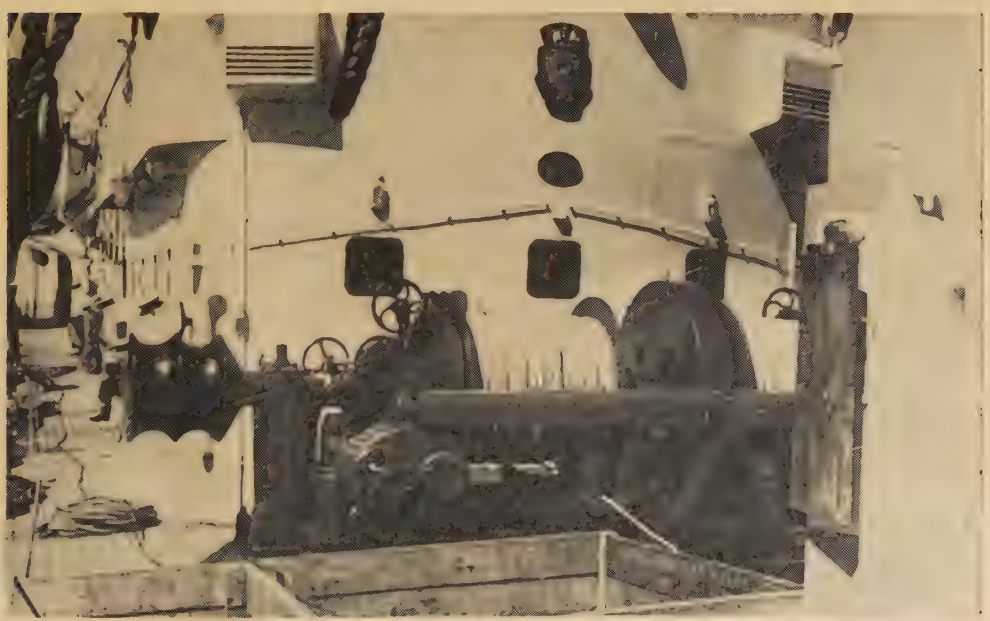


FIG. 2.—ROBERTSON "BEAR ISLAND" TRAWL-WINCH WITH AUTOMATIC GUIDING GEAR.
[*Photos : J.M.M.*

PLATE VIII.

FIG. 1.—TYNE METAL CO. TRAWLING SHEAVE ROLLER BOLLARD WITH MUNRO FATHOM-RECORDING CLOCK. NOTE ROW OF SIX DEEP-SEA REVERSING WATERBOTTLES ON FORECASTLE BULKHEAD.

FIG. 2.—MECHAN TORPEDO-TYPE DAVIT AND CLARKE CHAPMAN SCIENTIFIC WINCH ON POOP DECK.

[*Photos: J.M.M.*

FIG. 3.—FORWARD HYDROLOGICAL MACHINE; ONE OF A FLIGHT OF SIX DEEP-SEA REVERSING WATERBOTTLES BEING BROUGHT INBOARD.

FIG. 4.—AFTER HYDROLOGICAL MACHINE; N 70 PLANKTON TOW-NET READY FOR SHOOTING.

[*Photos: S.G.G.*

PLATE IX.

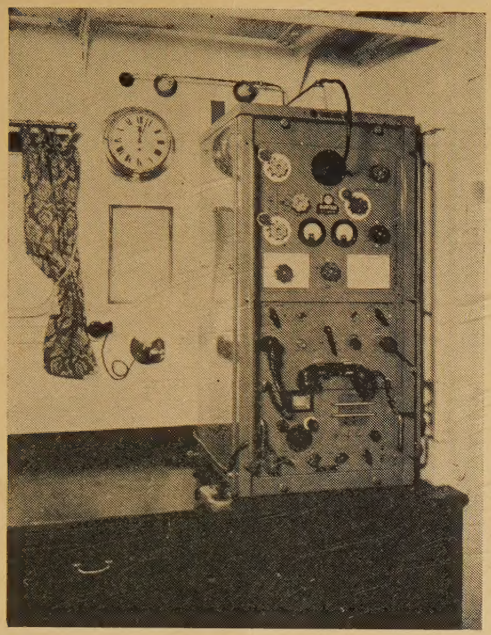


FIG. 1.—THE MARCONI "TRANSARCTIC" TRANSMITTER/RECEIVER INSTALLATION FITTED IN THE RADIO-ROOM.

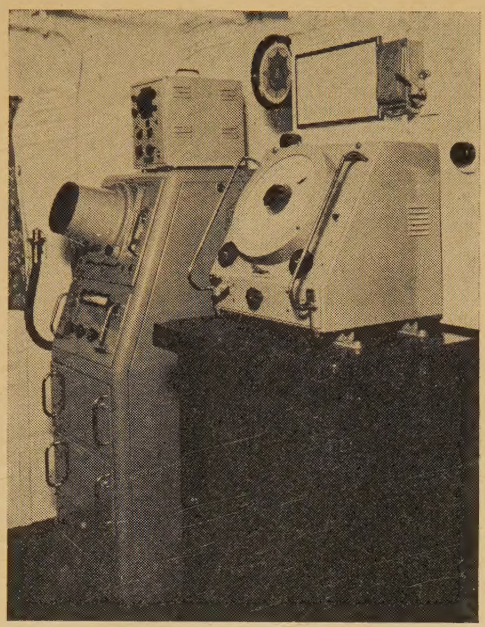


FIG. 2.—THE MARCONI "RADIOLOCATOR" RADAR CONSOLE AND "LODESTONE" DIRECTION-FINDER CABINET FITTED IN THE CHART-ROOM.

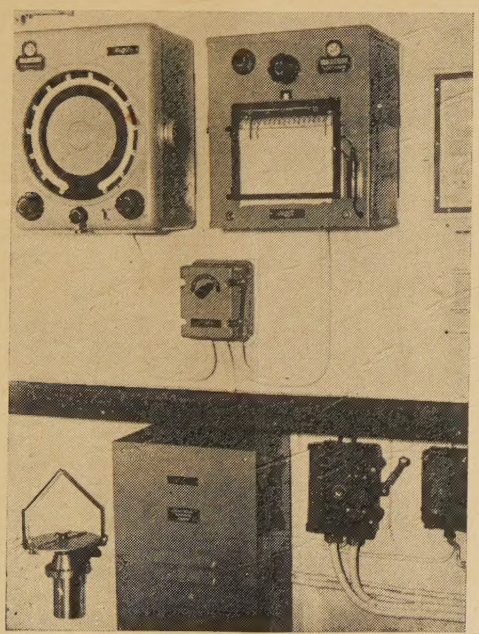


FIG. 3.—THE MARCONI "VISAGRAPH" ECHO-SOUNDER (THE VISUAL "SEAVISA" UNIT TO THE LEFT AND THE RECORDING "SEAGRAPH" UNIT TO THE RIGHT) FITTED IN THE WHEEL-HOUSE.

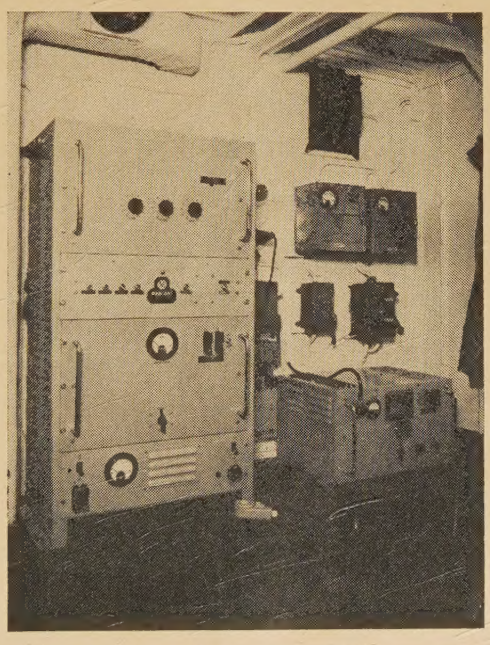


FIG. 4.—THE MARCONI "OCEANIC" SOUND-REPRODUCING EQUIPMENT FITTED IN THE RADIO-ROOM.

[*Photos: James Hall, Ltd., Greenock [by courtesy Marconi (S.A.) Ltd.*]